METHOD OF AND DEVICE FOR SENDING

5   INFORMATION TO MULTIPLE ADDRESSES

BACKGROUND INFORMATION

This invention relates generally to bundling data

for transmission over a network, such as the Internet.

10   The Internet includes a plurality of interconnected

computers, each computer having an address and one or

more communication lines. Many Internet server

applications produce a high volume of traffic. Often a

piece of information, such as an image corresponding to

15   a web page to be displayed on a user's computer, is sent

to many users during a short time span. Sending the

same piece of information to many users during a short

time span occupies a large amount of the available

bandwidth used to send information via the Internet.

20   When the bandwidth is in short supply, delays and

dropped information result. Accordingly, there is a

need to reduce the amount of bandwidth occupied by

sending a piece of information to many users during a

short time span.

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BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment of the invention is understood by referencing the following detailed description taken in conjunction with the accompanying drawings, in which:

5   Figures 1A and 1B is a block flow diagram in accordance with an embodiment of the invention;

Figures 2A and 2B is a block flow diagram in accordance with another embodiment of the invention;

Figures 3A and 3B is a block flow diagram in

10   accordance with another embodiment of the invention;

Figures 4A and 4B is a block flow diagram in accordance with another embodiment of the invention;

Figures 5A and 5B is a block flow diagram in accordance with another embodiment of the invention;

15   Figure 6 is a schematic block flow diagram illustrating a device according to an embodiment of the invention; and

Figure 7 is a schematic block flow diagram of a system utilizing devices and methods according to

20   embodiments of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Briefly, according to an embodiment of the invention, a reduction in the amount of bandwidth

25   occupied by sending a piece of information to many users

is achieved by bundling one such piece of information

with more than one address into a single packet. Such a

bundled packet is then sent via a network, and then

unbundled at some point prior to reaching the users.

5   The foregoing may be accomplished, briefly, by a method

of sending information via a network of computers

wherein an information packet is received, a plurality

of addresses corresponding to the information packet are

identified, and an acceptable next destination for each

10   address of the plurality of addresses is determined.

Then addresses having a network device as the acceptable

next destination are selected, and a bundled packet is

provided to the network device, the bundled packet

including the selected addresses and the information

15   packet.

A packet bundling device according to an embodiment

of the invention may include, briefly, a routing table

memory device which receives a plurality of addresses in

a bundled packet, an analysis circuit which determines

20   whether any of those addresses have a common next

destination indicated by the routing table and capable

of interpreting bundled packets, and a bundled packet

construction circuit which builds a bundled packet if

the analysis circuit determines that the addresses and

25   the common next destination satisfy certain conditions.

Figures 1A and 1B illustrate a method of sending

information via a communications network, according to

an embodiment of the invention. One type of

communications network to which the method may be

5   applied is a system of computers connected by

communications lines. In such a method an information

packet is provided 10, and a first address and a second

address are identified 13. Both the first address and

second address correspond to the information packet. A

10   determination is made 16 as to whether both the first

address and the second address can receive an

information packet sent via a first network device, such

as a router, switch or gateway. If an information

packet can be sent to an address via a network device,

15   the address is referred to herein as being "reachable"

via the network device. If both the first address and

the second address are determined to be reachable via

the first network device, a bundled packet is provided

19 to the first network device. The bundled packet

20   includes the first address, the second address and the

information packet.

An embodiment of a method according to the

invention may further include determining 22 whether

both the first address and the second address are

25   reachable via a second network device, such as a router,

switch or gateway. If both the first address and the

second address are determined to be reachable via the

second network device, the bundled packet is provided to

the second network device. However, if both the first

5   address and the second address are determined not to be

reachable via the second network device, then a

determination is made as to whether the first address is

reachable via the second network device, and if so, an

unbundled packet is provided 25 to the second network

10   device. The unbundled packet includes the first address

and the information packet.

The method may include making a determination 28 as

to whether the second network device is capable of

interpreting bundled packets. For example, if both the

15   first address and the second address are determined 22

to be reachable via the second network device, the

determination 28 as to whether the second network device

is capable of interpreting bundled packets is made. The

determination 28 as to whether the second network device

20   is capable of interpreting bundled packets may be made

by the first network device using a memory device that

stores a list of network devices connected to the first

network device and whether each of the network devices

on the list is capable of interpreting bundled packets.

If the second network device is determined to be capable of interpreting bundled packets, the bundled packet is provided 31 to the second network device. However, if the second network device is determined not to be capable of interpreting bundled packets, an unbundled packet, including the first address and the information packet, is provided 34 to the second network device. Another unbundled packet, including the second address and the information packet, may also be provided to the second network device.

A method according to an embodiment of the invention may also include determining whether a second network device resides between a user at the first address and the first network device. If a second network device is determined not to reside between the user and the first network device, then the information packet is provided to the first address.

Figures 2A and 2B illustrate an embodiment of a method of sending information via a network of computers according to the invention. The method may include providing 50 an information packet and identifying 53 a plurality of addresses corresponding to the information packet. For each address of the plurality of addresses, an acceptable next destination is determined 56. For example, an acceptable next destination may be a network

device that could receive the information packet as the
information packet travels to the address. Addresses
having a first network device as the acceptable next
destination are selected 59 to provide selected

5   addresses. Then a bundled packet is provided 62 to the
first network device. The bundled packet includes the
selected addresses and the information packet.

The method may continue by receiving 65 the bundled
packet at the first network device, and determining 68,

10   for each address in the bundled packet, an acceptable
next destination. Addresses in the bundled packet
having a second network device as the acceptable next
destination are chosen 71 to provide a group of chosen
addresses. A new bundled packet is then provided to the

15   second network device. The new bundled packet includes
the group of chosen addresses and the information
packet.

Prior to providing the new bundled packet to the
second network device, a determination 74 may be made as

20   to whether the second network device is capable of
interpreting bundled packets. If the second network
device is determined to be capable of interpreting
bundled packets, then the new bundled packet is provided
77 to the second network device. However, if the second

25   network device is determined not to be capable of

interpreting bundled packets, an unbundled packet is
provided 80 to the second network device. The unbundled
packet includes only one of the addresses in the group
of chosen addresses and the information packet.

5   Another embodiment of a method according to the
invention is illustrated in Figures 3A and 3B. Aspects
of this method (and other methods described below) that
are similar to aspects of the method illustrated in
Figures 2A and 2B have the same feature number, and will
10   not be discussed in detail below. The method
illustrated in Figures 3A and 3B may include determining
68, for each address in the bundled packet, an
acceptable next destination, and determining 100 whether
any of the addresses do not have a corresponding
15   acceptable next destination that is capable of
interpreting bundled packets. An address that does not
have a corresponding acceptable next destination that is
capable of interpreting bundled packets is chosen 103,
and an unbundled packet is provided 106 to the
20   acceptable next destination corresponding to the chosen
address. The unbundled packet includes the chosen
address and the information packet.

           In some situations, an address in the plurality of
addresses will not share an acceptable next destination
25   with another address in the plurality of addresses. As

shown in Figures 4A and 4B, in such situations the
address in the bundled packet that does not have an
acceptable next destination that is not also an
acceptable next destination of another of the addresses

5   in the bundled packet is chosen 200. Then an unbundled
packet, including the chosen one of the addresses and
the information packet, is provided 203 to the
acceptable next destination.

Figures 5A and 5B illustrate another embodiment of

10 a method according to the invention in which a
determination 300 may be made as to whether a second
network device resides between a user at one of the
plurality of addresses and the first network device. If
a second network device is determined not to reside

15 between the user and the first network device, then the
information packet is provided 303 to that one of the
plurality of addresses.

Figure 6 illustrates a packet building device 400
according to an embodiment of the invention. Such a

20 packet building device 400 may have a routing table
memory device 403. The routing table memory device 403
is capable of storing an address, a corresponding next
destination and a corresponding indicator. The
corresponding next destination for an address is along a

25 route from a network device, having such a packet

building device 400, to a user corresponding to the
address. The indicator indicates whether the
corresponding next destination is able to interpret
bundled packets.

5   The packet building device 400 also may have an
analysis circuit 406 that is capable of receiving and
analyzing a bundled packet received by the packet
building device 400 via a transmission line 409. A
bundled packet, having an information packet and a

10   plurality of addresses, received by the packet building
device 400 is sometimes herein referred to as an
"inbound bundled packet." The analysis circuit 406 is
capable of determining whether any of a plurality of
addresses bundled together in an inbound bundled packet

15   have a common next destination indicated by the routing
table. The analysis circuit 406 is also capable of
determining whether the indicator corresponding to the
common next destination indicates that the common next
destination is able to interpret bundled packets.

20   The packet building device 400 also may include a
bundled packet construction circuit 412. The bundled
packet construction circuit 412 is capable of building a
bundled packet if the analysis circuit 406 determines
that (a) two or more of the addresses among the

25   plurality of addresses have the common next destination,

and (b) the common next destination is able to interpret
bundled packets. A bundled packet built by the bundled
packet construction circuit 412 is sometimes herein
referred to as an "outbound bundled packet." The

5   outbound bundled packet includes the information packet
and the two or more addresses among the plurality of
addresses that have the common next destination. An
outbound bundled packet may be provided along a second
transmission line 415.

10   The packet building device 400 may also have an
unbundled packet construction circuit 418 capable of
building an unbundled packet to be provided by the
network device. An unbundled packet to be provided by
the network device is sometimes referred to herein as an

15   "outbound unbundled packet." The outbound unbundled
packet includes the information packet, and may also
include one address. The outbound unbundled packet is
built if the analysis circuit 406 determines that an
address among the plurality of addresses does not have a

20   corresponding next destination that is also the next
destination corresponding to another of the addresses
among the plurality of addresses. The outbound
unbundled packet is also built if the analysis circuit
406 determines that the next destination corresponding

25   to an address among the plurality of addresses is not

able to interpret bundled packets. An outbound

unbundled packet may be provided along the second

transmission line 415.

Figure 7 shows a system utilizing devices and

5   methods according to an embodiment of the invention. A

general overview of methods and devices according to the

invention will be described using Figure 7. Figure 7

includes a number of network devices labeled "Compliant

Router," and these devices have a packet building device

10 400 according to an embodiment of the invention. Figure

7 also includes a number of network devices labeled

"Non-Compliant Router," and these devices do not have a

packet building device 400 according to the invention.

The system depicted in Figure 7 shows the network

15 devices as routers, and it is understood that a system

according to this embodiment of the invention may

include switches (compliant and non-compliant) and

gateways (compliant and non-compliant).

The web server 500 illustrated in Figure 7 may

20 include a packet building device 400 that builds a

bundled packet (using a bundled packet construction

circuit 412) having an information packet and a list of

addresses, Address A through Address H. The bundled

packet may be provided by the web server 500 via a first

25 transmission line 503 to compliant router A. Compliant

router A determines that all of the addresses in the
bundled packet, Address A through Address H, are
reachable via compliant router B, and sends the bundled
packet along a second transmission line 506 to router B.

5 Router B determines that Address A and Address B are
reachable via compliant router C, but Address C through
Address H cannot be reached through router C. Router B
then builds a first new bundled packet (using a bundled
packet construction circuit 412) having the information

10 packet and a list of addresses, Address A and Address B.
The first new bundled packet is provided to compliant
router C via a third transmission line 509. Router C
recognizes that there are no more routers between router
C and the users corresponding to Address A and Address

15 B. Router C provides the information packet to users at
Address A and Address B.

Router B also determines that Address C through
Address H can be reached through compliant router D, and
builds a second new bundled packet (using a bundled

20 packet construction circuit 412) having the information
packet and an address list with Address C through
Address H. The second new bundled packet is provided to
router D via a fourth transmission line. Router D
determines that Address C and Address D are reachable

25 via non-compliant router E, and also determines that

router E is not capable of interpreting a bundled

packet. Router D builds an unbundled packet (using an

unbundled packet construction circuit 418) having the

information packet and Address C and provides this

5   unbundled packet to router E via a fifth transmission

line 515. Router D also builds an unbundled packet

(using an unbundled packet construction circuit 418)

having the information packet and Address D, and

provides this unbundled packet to router E via the fifth

10   transmission line 515. Router E receives both of the

unbundled packets, and provides the information packet

to the users corresponding to Address C and Address D.

        Although one or more embodiments of the invention

have been described, it will be understood that other

15   embodiments of the invention may be made without

departing from the spirit and scope of the invention.